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ABSTRACT

The reforms currently proposed by educators and policymakers are based on two categories of assumptions: (1) changes in school organization will increase effective use of scarce resources; and (2) choices made by parents and children will effectively "match" students to appropriate learning environments. This paper presents a dynamic model of schooling that simulates student progress through several elementary school grades. The model accommodates the resource allocation and matching interventions found in reform policies and also recognizes the influence of student and family conditions on learning readiness and participation. The model utilizes data from a large metropolitan school district to incorporate the effects of risk factors. By varying model parameters, users can assess the dynamics of reform policy on schools and selected learner populations, raise risk-amelioration issues pertaining to particular school districts, and examine human service policy-balancing questions in selected school communities. The model clearly shows that current educational reform policies are not particularly effective in serving at-risk learners. When policies raise standards, there is increase in time needed to learn, and school resources are quickly depleted. Where students choose among alternative programs, those with highly adaptive behavior seek out schools where time spent in learning is available, leaving the less-adaptive student in a time-constrained environment. The model also demonstrates the need to include human service programming as an integral part of any reform intended for at-risk learners. (15 references) (Author/MLH)

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THE DYNAMICS OF EDUCATIONAL REFORM: Simulation Studies of Educational Policy

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ABSTRACT:

The reforms currently proposed by educators and policy makers are based on certain assumptions concerning the nature of school organization and the learning process that goes on within it. These assumptions generally fall under two broad categories: a) changes in the organization of schools will result in more effective use of scarce resources and b) choices made by parents and children will effectively "match" students to appropriate learning environments. While there may be some research support for these beliefs, there have been few, if any, attempts to examine how they play out in the social system of the typical school.

This paper presents a simple dynamic model of schooling which simulates student progress though several elementary school grades. By focusing on time-related variables associated with schooling the model can accommodate the resource allocation and matching interventions found in reform policies. However, the model goes beyond the boundaries of the school to recognize the influence of student and family conditions on readiness for, and participation in, the learning process. This is done by drawing on research on learners at risk to build a developmental sub model which sets limits on the capacity of students to benefit from the changes brought about by educational reforms.

The resulting model has been developed to reflect a typical set of educational reform policies. It also utilizes data from a large metropolitan school district to incorporate the effects of risk factors. By varying the parameters of the model, users can:

a) assess the dynamics of reform policy on schools and selected learner populations.
b) raise issues as to risk-amelioration in the context of particular school districts.
c) examine human service policy-balancing questions in selected school communities.

The model also provides a training platform where policy makers and school managers can experiment with the assumptions of the model and the effects of policies on learner outcomes.

PERSPECTIVES:

An analogy will help the reader understand the model proposed in this paper. Suppose that there is a cancer whose cure rate is very low and that it is treatable only at great cost. Further, suppose that there is an environmental cause for the disease which can be eradicated only by substantial investments over a long period of time. Now, let there be a public policy which desires to contain the cost of medical care. In this scenario, it is easy to imagine reformers urging a medical **perestroika** to make hospitals user friendly; or enacting legislation which would hold physicians accountable for the outcomes of care; and, possibly, increased client choice among alternative treatments. If our health policy experts behave like their educational colleagues we could not imagine them addressing

the fundamental fact that *both* treatment and prevention cost money.

This analogy highlights the characteristics of present day educational reforms: restructure, assign accountability and increase client options. It also points up the fact that there at least three major dynamics at work in most human service problems. First, there are the demographics and social conditions which underlay service needs. There are the changes in communities and families which have resulted in the cancer of increased numbers of learners at risk. (Willis, 1989) Second, there is the service delivery process itself where professional knowledge and skill is brought to bear on client problems. Teaching and learning are at the core of this dynamic which attempts to diagnose leaner needs and match them to appropriate instructional interventions. (Logan-Woods, 1989) Finally, there is an organizational dynamic which coordinates the work of service delivery professionals. In this dynamic, the school organization provides a framework for allocating resources and making decisions as to which students are to be the beneficiaries of scarce resources. (Levin, 1989)

In this paper, these three dynamics are brought together in a simulation model where various educational reform policies can be tested. The central dynamic in the model - that of teaching and learning - is structured to represent Carroll's (1963) model of school learning where the parameters are *Time Needed To Learn (TNTL)* and *Time Spent In Learning (TSIL)*. (Gettinger, 1984) The time allocation decisions of teachers are incorporated by taking teacher expectations into account. This accomplished through feedback of prior student performance so that the model "tracks" the simulated learning behavior of its student cohort. (Rolison and Medway, 1985) Thus, the model effectively apportions additional *TSIL* to those students whose performance lags expected grade level achievement.

Time Needed To Learn enters the model via the **adaptive behavior** of students. (McCarney, 1983) These are behaviors which teachers expect of students according to shared assumptions about child development. Since these behaviors are linked to the family and demographic backgrounds of learners, they represent the consequences of social risk as seen by the school. They are, however, behaviors which are responsive to interventions by schools and other human service agencies. (Hoopman and Rivkin, 1990)

The model positions these dynamics so that resources can be allocated to either (or both) teaching time or adaptive behavior development. The policy problem this presents is one which requires a shift in resource allocation in response to changes in the risk status of learners. If this does not occur, the increase of *TNTL* quickly uses up educational resources.

The relationships among these variables can be diagrammed using the conventions of Systems Dynamics.

FIGURE 1
ABOUT HERE

In this drawing, arrows indicate the direction of causal influence and (+) signs that changes in cause and effect variables operate in the *same direction*. That is, increases in a cause variable result in increases in the associated effect variable and conversely. Negative (-) signs indicate that changes in cause and effect operate in *opposite directions*.

Thus, Figure 1 can be read as follows. *Increases* in the level of Adaptive Behavior result in *decreases* in TNTL. This *reduces* the need for Time Spent on Behavior (TSOB) and *increases* TSIL. The net result is an *increase* in the Level of Mastery attained by students. Over time, this *increase* in Mastery "feeds back" on Adaptive Behavior to raise the over-all level of student integration into the social system of the school. If Adaptive Behavior declines, all these effects are reversed and the Level of Mastery declines as does Adaptive Behavior.

This simple model becomes problematic when we factor in the effects of differences within student populations and the varying capacity of schools to alter TSIL-related variables. It is further complicated by such reform policies as school choice which, we argue, can act to place inordinate TNTL pressures on the very schools who have the least capacity to respond with appropriate adjustments in TSIL.

METHOD:

To examine the implications of the above contention, we have developed a simulation model in which the interaction of TNTL, TSIL, Adaptive Behavior and school capacity can be examined. Our model is based on a traditional view of age-graded schooling in which students progress through a series of levels dependent upon mastery of learning tasks.

FIGURE 2
ABOUT HERE

The model diagrammed in Figure 2 differs from others (Wiley and Harnischfeger, 1974; Gettinger, 1985) in that TNTL is determined by the level of Adaptive Behavior (AB) of the student. That is, the higher the level of AB, the less the TNTL. The reasoning underlying this relationship are clear; schools expect certain behavior patterns of their students and are able to accommodate only a relatively narrow range of behavior differences. Consequently, when the Adaptive Behaviors of entering students deviate from these expectations, the school must take time out from instruction to help students acquire the skills needed to take advantage of learning opportunity. It follows that schools facing changes in the Adaptive Behavior of students will take class and teacher time away from learning and will, as a result, perform less well on traditional academic measures of student progress. This is shown in the above flowchart as a link to Effective Learning Time (EFLT).

FIGURE 1
ADAPTIVE BEHAVIOR AND THE USE OF SCHOOL TIME

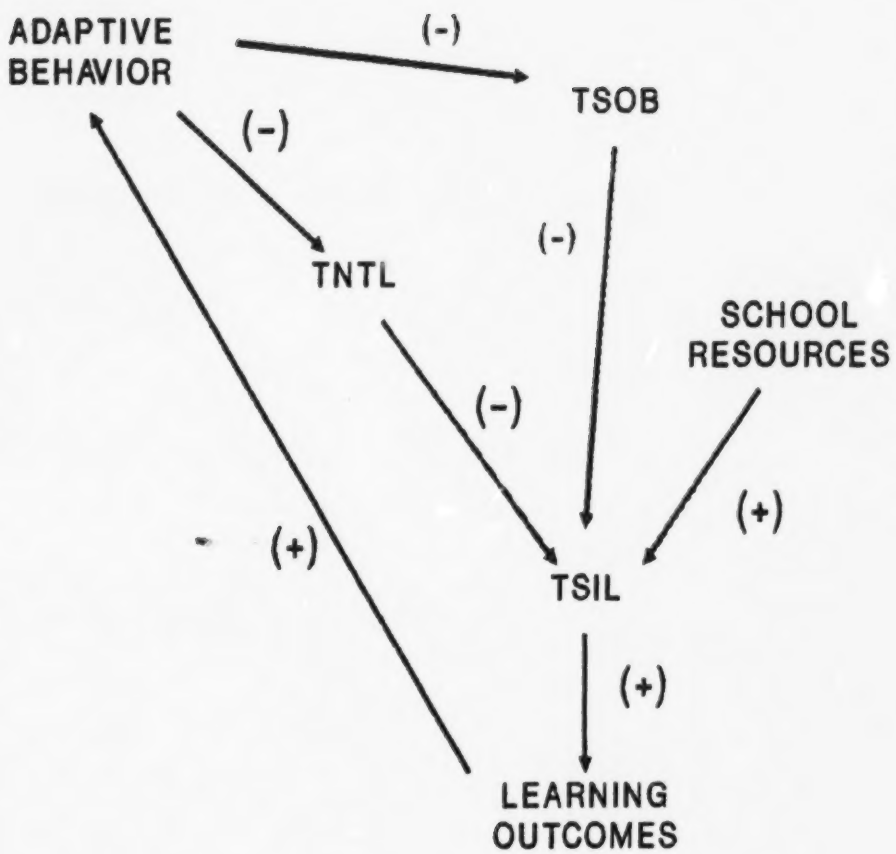
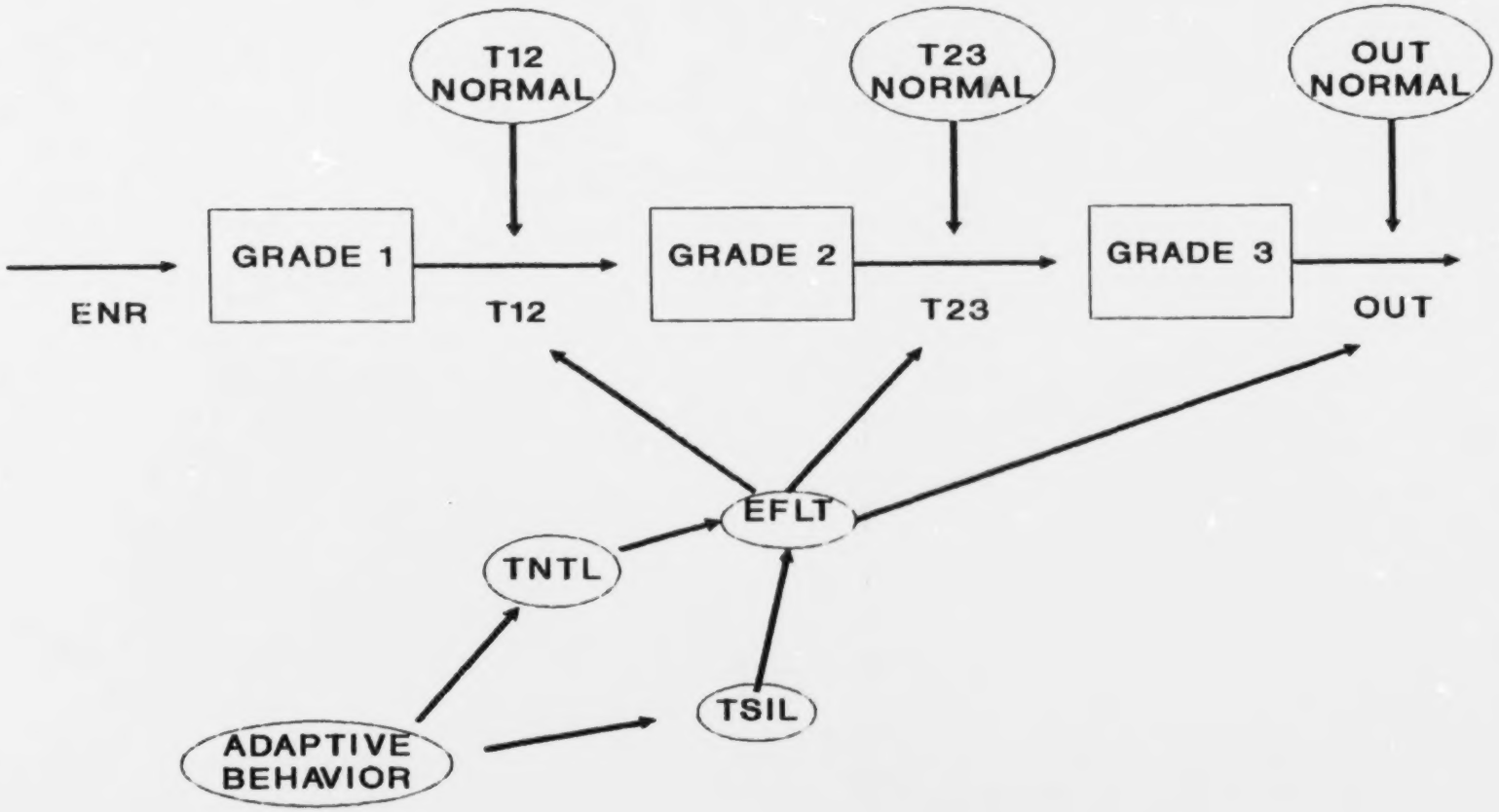


FIGURE 2
BASIC POLICY MODEL



We have attempted to document the relationships suggested in the above paragraph by studying the Adaptive Behavior of elementary school children in several districts. (Noennig, 1988; Rajanen, 1989; Snyder, 1991) These studies lend support to the key assumptions underlying our policy model. First, Adaptive Behavior is directly linked to instructional outcomes. Second, correcting Adaptive Behavior takes time away from learning activities - effectively reducing TSIL in those schools with lower average AB scores. Finally, students with low Adaptive Behavior scores require additional time to master academic tasks - low AB scores increase TNTL. When these variables are in balance, the EFTL is adequate to meet student needs; when they are out of balance due to increased TNTL and increased TSOB, the school can no longer respond to demand.

These findings are used as the foundation of our policy model where we create plausible links which show how Average Adaptive Behavior scores relate to TNTL and TSIL. The two dependent variables are scaled to show the impact on "time" likely to be associated with given AB scores. The "multipliers" derived from these curves are applied to "normal" values of TNTL and TSIL. For example, the Adaptive Behavior Evaluation Scale used in our research has an average score. (McCarney, 1983) At this value, both TNTL and TSIL multipliers are equal to one so the instructional process is in a "normal" balanced relationship with its clientele. As AB increases, the TNTL mulitplier *decreases* and the TSIL multiplier *increases*. This has the effect of "leveraging" the capacity of the school to do its work; it can not only spend more time in direct instruction - its clients need less time to achieve mastery. At the other end of the scale, "leverage" works against the school and students; low AB scores result in an *increase* in the TNTL multiplier and a *decrease* in the TSIL multiplier. These schools are "swamped" with behavior problems and cannot reach normal performance levels unless the school has the resources to increase TSIL.

It is these "leverage" differences which, we believe, put many of the popular educational reforms at risk of failure. If schools cannot quickly respond to declines in the Adaptive Behavior of students, they find "leverage" working against them and scarce teacher resources are stretched to cover increasing student needs. When reform policies - such as free choice of schools - are instituted where schools have wide differences in the level of Adaptive Behavior of their students, able students will gravitate to the more effective schools. This leaves the less effective school with a lower level of Adaptive Behavior and it becomes even less effective. To see how the dynamics of choice might affect school performance, we have programmed a simple "reform model" which incorporates the findings of our research to date.

The model is written in DYNAMO, a system dynamics simulation language. (Roberts, 1987) It makes use of adaptive behavior studies of elementary school children in a large metropolitan school district to represent the impact of changes in student characteristics on *TNTL* and actual *TSIL*. These changes are factored into the model as modifications on

historical ("normal") transition rates among the three lower elementary school grades. Two outputs of the model are instructive:

First, the model clearly gives a vivid picture of the effect of Adaptive Behavior on school performance. In Figure 3, we show a plot of the retention of students at grade 1 under "above average" and "below average" Adaptive Behavior scores.

FIGURE 3
ABOUT HERE

This output reflects the model's initial capacity to process 85% of incoming students when the Adaptive Behavior score is "average". When the score is "below average", retention increases and the grade "fills up". Conversely, when Adaptive Behavior is "above average", the school retains few students and all incoming students complete their work on time.

So far the argument for Adaptive Behavior effects on performance are generally supported by the literature. Where we break new ground, is when we allow students and parents to choose among schools with differing levels of Adaptive Behavior and differing patterns of student progression through grades. When this reform policy is instituted, it is generally the informed parent and the student with a high level of Adaptive Behavior who chooses a different school. (Snyder, 1991) Then, the "leverage" described above begins to work and some schools become even more effective as their students' Adaptive Behavior increases and others are quickly left behind as their more functional students leave them.

The choice scenario described above can be examined in our model by creating two schools with initial differences in their average levels of Adaptive Behavior. Students with "above average" levels of Adaptive Behavior are able to move to the higher-performing school. We have programmed our model such that increased over-all school performance enhances the probability that an "above average" student will select it. The result is shown in the two performance curves in Figure 4.

FIGURE 4
ABOUT HERE

We can see that, over time, the lower-performing school declines in its ability to move students along and the higher-performing school continues to improve.

We have attempted to validate the assumptions of our model using case studies of schools with contrasting average levels of Adaptive Behavior of students. These studies can be summarized in a simple scenario which pictures a typical suburban school where in-migration has lowered the average Adaptive Behavior score of students. In 1980, this school was clearly a high performer. It had a class size of 24 students all scoring at the upper end of the Adaptive Behavior scale. Consequently, little

FIGURE 3
THE IMPACT OF ADAPTIVE
BEHAVIOR ON TNTL/TSIL

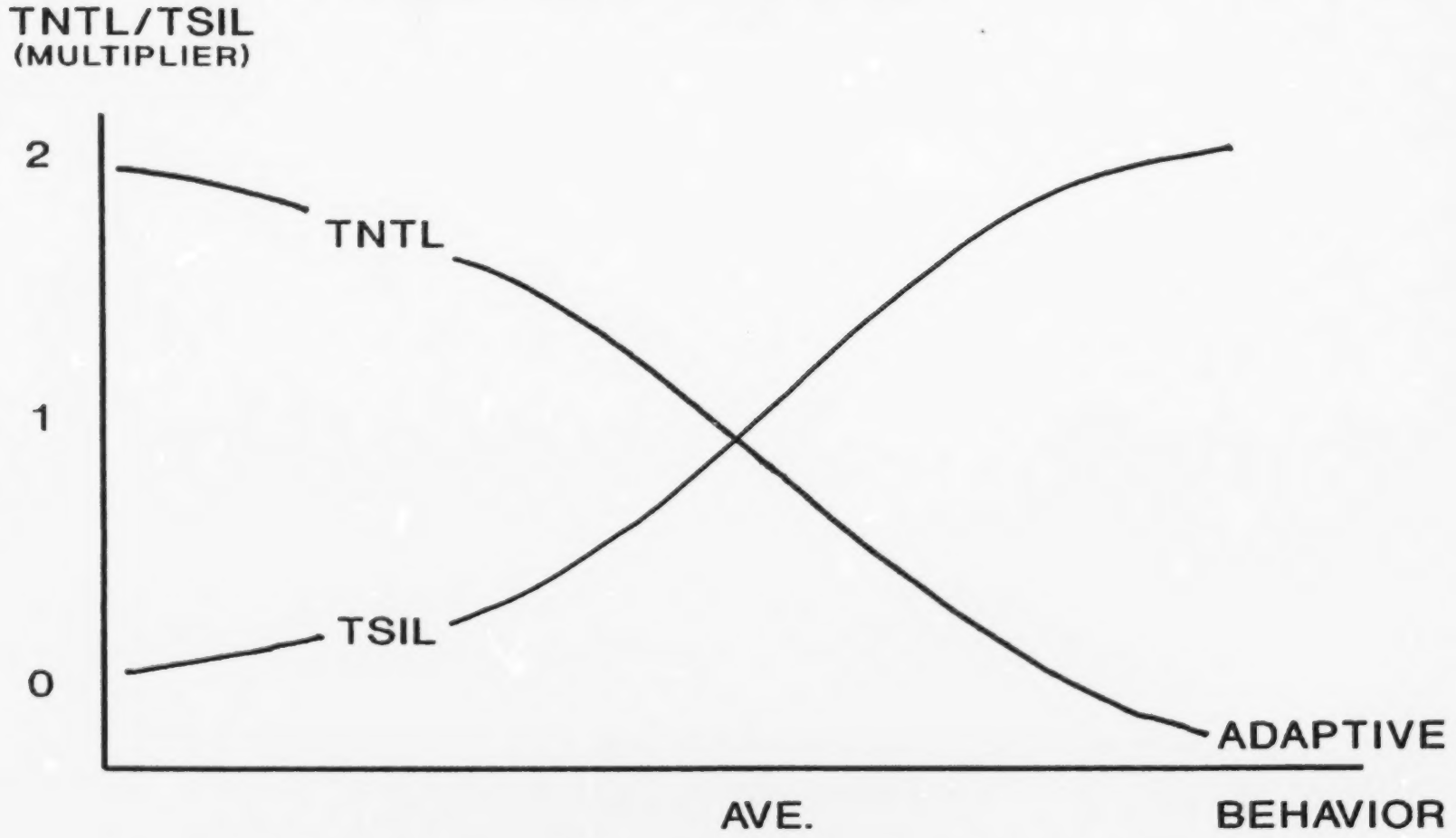
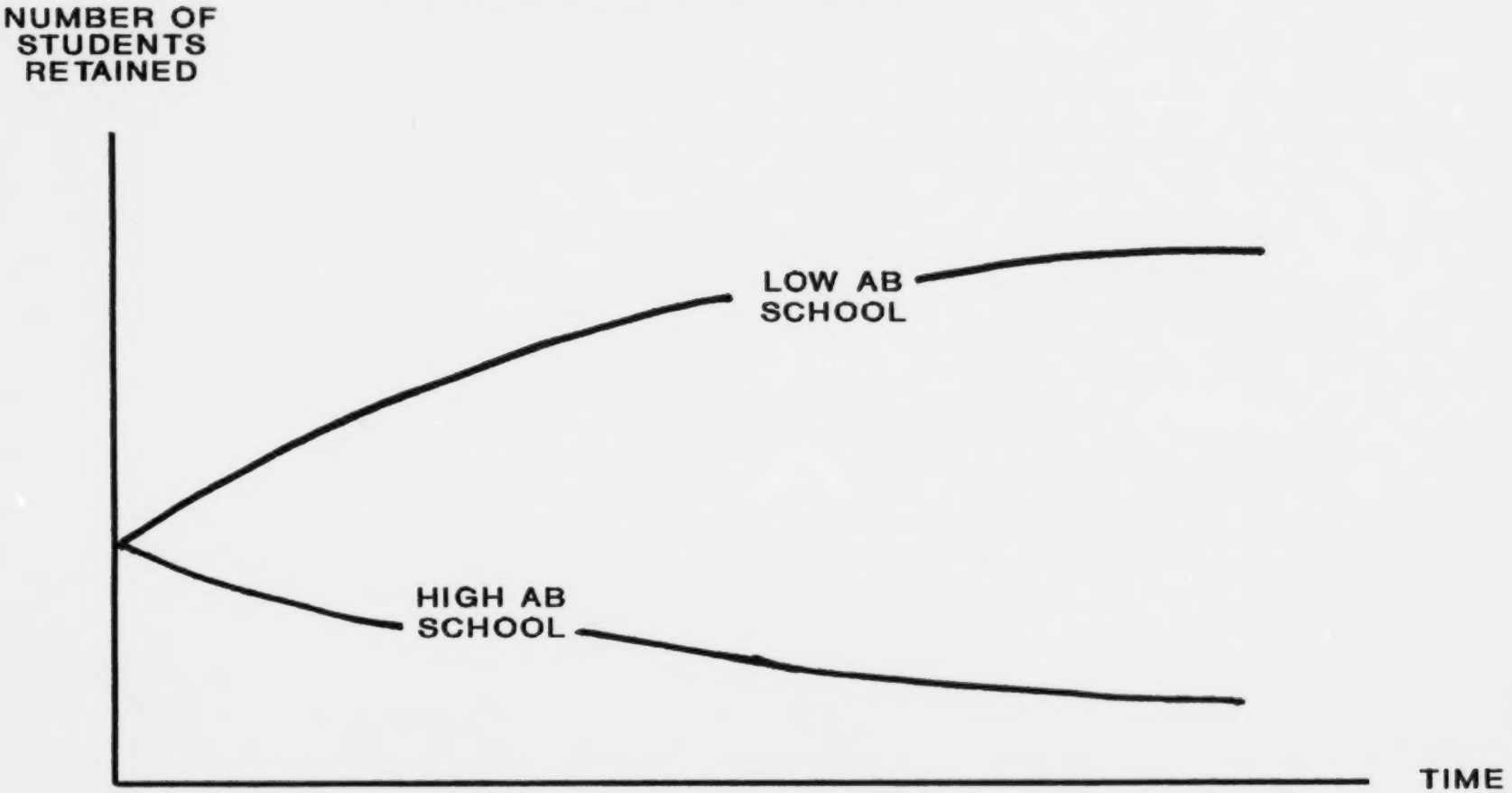


FIGURE 4
STUDENT CHOICE
AND SCHOOL PERFORMANCE



time was spend on behavior and virtually all teacher and student time was effective TSIL.

Over the past decade, this school has changed dramatically. In-migration has lowered the Adaptive Behavior profile of students so that 60% have an ABES score below the national average. Reductions in staffing have raised the typical class size to 30 students and inclusion policies have added 4-5 special needs children into the classroom. Further, and most distressing, choice policies have resulted in the out-migration of learners with high Adaptive Behavior scores to less severely impacted schools in the area.

The net of these dynamics is a school which is itself at risk. (Ammentorp and Weatherman, 1989) Its resources are thinly stretched and disproportionately allocated to behavior even though its clients have increasing needs for TSIL. Each year, the proportion of "Adaptive" students declines as more families choose alternative schools. And, all objective measures of outcomes continue to decline such that the school can no longer attract dedicated teachers and able students. In effect, the very educational reforms meant to correct the problems of this school have served to increase them to the point where the school can no longer deliver on its obligations to children.

RESULTS:

In interpreting the results of our simulation studies, the reader must recognize that our model is but a heuristic device and not a fully identified model of school choice. If it is approached in this spirit, it raises several questions about school reform and the variables which must be included in policy debates.

The model clearly shows that current educational reform policies are not particularly effective in dealing with learners at risk. When policies raise standards, there is an increase in *TNTL* and school resources are quickly depleted. Where students choose among alternative programs, those with high levels of **adaptive behavior** seek out schools where *TSIL* is available, leaving the less adaptive student in a time-constrained environment. Finally, the model demonstrates the need to include human service programming as an integral part of any educational reform that proposed to respond to the needs of at-risk learners.

The implications for educational reform seem clear to us. If "choice" is to be the preferred method for school improvement, then substantial efforts must be made to ensure that *every* child and parent has the information needed to evaluate options and the means to access the schools they select. In addition, those charged with the administration of reform policy must be constantly vigilant to prevent the emergence of "failed schools" populated by students who cannot choose. The potential risk of the "choice option" is high as Stuart Maclure noted in his critique of British magnet schools (Sunday Times, June 18, 1989)

"Schools . . . could eventually fall into three groups. First, the elite high-performing schools, City Technology

Colleges, opted-out schools and local authority Magnet Schools . . .; then a larger group of "run of the mill" institutions delivering the standard national curriculum; and finally the deprived "sink" schools, mostly in the inner cities, with larger numbers of people who speak English as a second language." (quoted in Boyd, 1991)

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